



PHYSICS TRICKS & TIPS

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1. QUICK PHYSICS TOOLKIT

- Write every quantity with its SI unit: m, kg, s, A, K, mol, cd.
- **Dimensional check: both sides of an equation must have matching dimensions.**
- Use dimensions to test a formula, not to find pure numbers such as 2 or pi.
- Convert units before substituting values; keep powers of ten visible.
- Vector quantities have magnitude and direction; scalar quantities have magnitude only.

2. KINEMATICS SHORTCUTS

- **$v = u + at$ | $s = ut + \frac{1}{2}at^2$ | $v^2 = u^2 + 2as$**
- Use these equations only when acceleration is constant.
- Slope of a displacement-time graph = velocity; slope of a velocity-time graph = acceleration.
- Area under a velocity-time graph = displacement; use speed for total distance.
- **Equal distances: average speed = $\frac{2v_1v_2}{v_1 + v_2}$.**
- Choose one positive direction and keep signs consistent.

3. PROJECTILE MOTION

- Split launch speed into components: $u_x = u \cos\theta$ and $u_y = u \sin\theta$.
- **$T = \frac{2u \sin\theta}{g}$ | $H = \frac{u^2 \sin^2\theta}{2g}$**
- **Range $R = \frac{u^2 \sin(2\theta)}{g}$ (same launch and landing height).**
- For a fixed speed, maximum range occurs at 45° on level ground.
- Complementary angles give the same range under ideal conditions.
- At the highest point $v_y = 0$, but horizontal velocity remains $u \cos\theta$.

4. NEWTON'S LAWS & FRICTION

- **Net force: $\sum F = ma$ | Equilibrium: $\sum F = 0$**
- Draw a free-body diagram first; include only forces acting on the chosen object.
- Static friction adjusts up to its limit: $f_s \leq \mu_s N$; at impending slip, $f_s = \mu_s N$.
- **Kinetic friction: $f_k = \mu_k N$.**
- On an incline: weight components are $mg \sin\theta$ down the slope and $mg \cos\theta$ normal to it.
- Elevator: apparent weight $N = m(g + a)$ when accelerating up; $N = m(g - a)$ when accelerating down.

5. MOMENTUM & IMPULSE

- **Momentum $p = mv$ | Impulse $J = \Delta p = F_{avg} \Delta t$**
- In an isolated system, total momentum is conserved during a collision.
- Longer stopping time means smaller average force for the same momentum change.
- **Perfectly inelastic: $v = \frac{m_1u_1 + m_2u_2}{m_1 + m_2}$.**
- In an elastic collision, both momentum and total kinetic energy are conserved.
- Use a consistent sign convention for velocities before applying conservation.

6. CIRCULAR MOTION

- **$v = \omega r$ | $a_c = \frac{v^2}{r} = \omega^2 r$**
- **Required inward net force: $F_c = \frac{mv^2}{r}$.**
- "Centripetal force" is the name for the net inward force, not an extra force.
- Period and angular speed: $T = \frac{2\pi}{\omega}$.
- **Ideal banked road: $\tan\theta = \frac{v^2}{r \cdot g}$ (no friction assumed).**
- Centripetal acceleration points toward the centre, even when speed is constant.



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1. WORK, ENERGY & POWER

- Work $W = Fs \cos\theta$ | $K = \frac{1}{2}mv^2$
- Net work = change in kinetic energy: $W_{\text{net}} = \Delta K$.
- If force and displacement are perpendicular, work done by that force is zero.
- Near Earth's surface, gravitational potential energy change = $mg\Delta h$.
- Spring energy $U = \frac{1}{2}kx^2$ | Power $P = W/t = F \cdot v$.
- For conservative forces, mechanical energy $K + U$ stays constant if no non-conservative work is done.

2. ROTATION & ROLLING

- Torque $\tau = rF \sin\theta$ | Fixed-axis rotation: $\tau_{\text{net}} = I\alpha$.
- Torque is greatest when the force is perpendicular to the lever arm.
- Angular momentum $L = I\omega$; if external torque is zero, L is conserved.
- Pure rolling: $v_{\text{cm}} = \omega R$.
- Rolling kinetic energy = $\frac{1}{2}Mv_{\text{cm}}^2 + \frac{1}{2}I_{\text{cm}}\omega^2$.
- Static equilibrium needs both $\sum F = 0$ and $\sum \tau = 0$.

3. GRAVITATION & SATELLITES

- $g = GM/R^2$ | Escape speed $v_e = \sqrt{2gR}$.
- Circular orbit: $v_{\text{orbit}} = \sqrt{GM/r}$.
- At altitude h : $g(h) = g_0[R/(R+h)]^2$.
- Gravitational potential energy for zero at infinity: $U = -GMm/r$.
- Kepler: T^2 proportional to r^3 for bodies orbiting the same central mass.
- Astronauts feel weightless in orbit because they and the spacecraft are in free fall.

4. FLUIDS & PRESSURE

- Pressure $P = F/A$ | At depth h : $P = P_0 + \rho gh$.
- Buoyant force equals the weight of displaced fluid: $F_B = \rho_{\text{fluid}} V_{\text{displaced}} g$.
- Continuity for incompressible flow: $A_1 v_1 = A_2 v_2$.
- In a narrower section of an ideal horizontal pipe, flow speed rises and pressure falls.
- Bernoulli: $P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$.
- Use Bernoulli only for steady, incompressible, non-viscous flow along a streamline.

5. HEAT & THERMODYNAMICS

- Temperature change: $Q = mc\Delta T$ | Phase change: $Q = mL$.
- Ideal gas: $PV = nRT$.
- During a pure phase change, heat changes the phase while temperature stays constant.
- First law: $Q = \Delta U + W$ (W = work done by the system).
- At constant volume, expansion work is zero, so $Q = \Delta U$ for a closed system.
- Track signs and units carefully; heat and temperature are not the same quantity.

6. SHM & WAVES

- SHM: $a = -\omega^2 x$ | $v_{\text{max}} = \omega A$ | $a_{\text{max}} = \omega^2 A$.
- Spring: $T = 2\pi\sqrt{m/k}$; simple pendulum: $T = 2\pi\sqrt{L/g}$.
- Pendulum formula assumes small oscillations; its period is independent of bob mass.
- Wave speed $v = f\lambda$.
- When a wave enters another medium, frequency stays the same; speed and wavelength may change.
- Keep amplitude, frequency, angular frequency and time period distinct: $\omega = 2\pi f = 2\pi/T$.



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1. ELECTROSTATICS

- Coulomb force: $F = k \cdot \frac{q_1 \cdot q_2}{r^2}$, where $k = \frac{1}{4\pi\epsilon_0}$ in vacuum.
- Electric field $E = F/q_{test}$; point charge: $E = \frac{k \cdot Q}{r^2}$.
- Potential of a point charge: $V = \frac{k \cdot Q}{r}$ (sign follows Q).
- Electric field is a vector; electric potential is a scalar. Add them accordingly.
- Capacitor: $C = Q/V$; parallel plates: $C = \frac{\epsilon_0 \cdot A}{d}$.
- Capacitors: parallel $C_{total} = \sum C$; series $\frac{1}{C_{total}} = \sum \frac{1}{C}$. Energy $U = \frac{1}{2} CV^2$.

2. CURRENT ELECTRICITY

- Ohm's law: $V = IR$ | $P = VI = I^2 R = \frac{V^2}{R}$.
- Resistor: $R = \frac{\rho L}{A}$.
- Series resistors: $R_{total} = \sum R$; parallel resistors: $\frac{1}{R_{total}} = \sum \frac{1}{R}$.
- For a cell supplying current, terminal voltage $V = E - Ir$.
- Balanced Wheatstone bridge: $\frac{P}{Q} = \frac{R}{S}$ (with corresponding arms).
- Check whether the question gives voltage or current before choosing a power formula.

3. MAGNETISM & EMI

- Magnetic force: $F = |q|vB \sin(\theta)$; wire: $F = BIL \sin(\theta)$.
- Magnetic force is zero when v is parallel to B and maximum when perpendicular.
- Long straight wire: $B = \frac{\mu_0 I}{2\pi r}$.
- Flux in uniform B: $\Phi = BA \cos(\theta)$ (θ is between B and area normal).
- Faraday: induced emf $\epsilon = -\frac{d\Phi}{dt}$.
- Lenz's law: induced current opposes the change in magnetic flux that produces it.

4. RAY OPTICS

- Mirror/lens formula: $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ (use one sign convention consistently).
- Mirror magnification $m = -\frac{v}{u}$; thin-lens magnification $m = \frac{v}{u}$.
- Snell's law: $n_1 \sin i = n_2 \sin r$.
- Total internal reflection needs travel from higher n to lower n and incidence above critical angle.
- Critical angle: $\sin C = \frac{n_{rarer}}{n_{denser}}$; lens power $P = \frac{1}{f}$ (f in metres).
- Draw a quick ray diagram to check whether the image is real/virtual and upright/inverted.

5. MODERN PHYSICS

- Photon energy: $E = hf = \frac{hc}{\lambda}$.
- Photoelectric effect: $K_{max} = hf - \phi = eV_s$.
- Increasing light intensity raises photoelectron count, not maximum kinetic energy at fixed frequency.
- de Broglie wavelength: $\lambda = \frac{h}{p}$.
- Bohr levels for hydrogen-like atoms: $E_n = -13.6 \frac{Z^2}{n^2} \text{ eV}$.
- Radioactive decay: $N = N_0 \left(\frac{1}{2}\right)^{(t/T_{1/2})}$. After 3 half-lives, $\frac{1}{8}$ remains.

6. SMART NEET SOLVING

- 1) Read what is asked; note the given values and convert to SI units.
- 2) Sketch the system: forces, rays, circuit or directions often reveal the method.
- 3) Write the governing law before substituting numbers.
- 4) Estimate the order of magnitude; reject options with impossible units or signs.
- 5) If stuck, mark it and return after securing easier questions.
- After every mock test, classify each error: concept, calculation, units, sign or time pressure.